Climate and Greenhouse Gases: A Graphing Exercise

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National Academic Standards:

Science

Science as Inquiry

- ✍ Abilities necessary to do scientific inquiry
- ✍ Understandings about scientific inquiry

Earth and Space Science

- ✍ Structure of the Earth system

Social Studies

People, Places, and Environments

- ✍ Describe, differentiate, and explain the relationships among various regional and global patterns of geographic phenomena such as landforms, soils, climate, vegetation, natural resources, and population.
- ✍ Propose, compare, and evaluate alternative policies for the use of land and other resources in communities, regions, nations, and the world.

Grades: 9-12

Subjects: Science, Social Studies

Objectives:

1. Compare temperature change over time with levels of different greenhouse gases in the atmosphere.
2. Discuss the relation between greenhouse gases and global temperature.
3. Make predictions about future global temperature change based on current levels of greenhouse gases.

Materials:

- ✍ Transparencies of the three Teaching Masters provided with this activity:
  - Local Temperature Change
  - Atmospheric Carbon Dioxide Levels over Time
  - Atmospheric Methane Levels over Time
- ✍ Transparencies of the three Student Worksheets provided with this activity:
  - Local Temperature Change
  - Atmospheric Carbon Dioxide Levels over Time
  - Atmospheric Methane Levels over Time
- ✍ Photocopies of the Data Table for students
- ✍ Wet-erase overhead markers (3 colors)

Doing the Activity:

1. Make a transparency of each of the three pre-graphed Teacher Masters (Local Temperature Change, Atmospheric Carbon Dioxide Levels over Time, and Atmospheric Methane Levels over Time).
2. Make at least one transparency of each blank Student Worksheet with the same titles as those above. You may want to make more than one set; these will each be distributed to groups of 2-4 students.
3. Divide the class into small groups.
4. Give each group one copy of the Data Table and one of the blank transparencies. Using "wet-erase" overhead markers, the students should graph the appropriate data onto their transparency. Each group should use a different color, unless more than one group is completing the same graph. Suggestion: Local Temperature Change = black, Carbon Dioxide = blue, Methane = red.
5. Once all graphs are complete, compare them with the pre-graphed masters. If everything appears to match, proceed. If a graph differs significantly, ask the group to re-do that graph.
6. Place the student version of the Local Temperature Change graph on the overhead. (If you have more than one student version of each graph, due to more than three working groups, then just choose one graph of each type to use in this exercise.)
7. Place the student version of the Atmospheric Carbon Dioxide graph on top of it. Discuss the similarities and differences.
8. Remove the Carbon Dioxide graph and replace it with the Atmospheric Methane graph. Discuss the similarities and differences.
9. Remove the Local Temperature Change graph and replace it with the Carbon Dioxide graph. Discuss the similarities and differences.
10. End with overlapping all three student graphs and discussing similarities and differences.

Background/Suggested Q&A:

1. What can these graphs tell you?

   That local temperature change, carbon dioxide, and methane are related in some way.

2. Do these graphs "prove" global warming?

   Not by themselves. These graphs can only demonstrate that the three factors (temperature, carbon dioxide, and methane) influence each other. The graphs alone cannot prove that one factor specifically influences the others (i.e., more carbon dioxide = higher temperature). Scientists use a variety of evidence to support or contradict global warming and climate change theories.

3. What other information would you need to help make a case for or against global warming?

   Data on other natural systems and human activities that can affect global temperature.

4. In 2002 the CO_2 measurement was 371 ppm. How does the rate of change from 1850 to 2002 compare to other time periods?

   The rate of change compares as follows:

   Over the 160,000 years, the maximum rate of change for CO_2 was about 5 ppm/1000 years. The increase in the last 150 years has been 91 ppm. This rate of change would be approximately 600ppm/1000 years. Based on prior changes – this rate of change has not been seen before.

5. What are the possible causes of the changes?

   Causes include burning of fossil fuels, deforestation, and other human activities. (See the Global Warming section on the EB Web site for further information).

6. What may this mean for the Earth's future climate?

   Climate change (see the Global Warming section on the EB Web site for further information).

7. Investigate the Kyoto Protocol. What are the actions proposed in the agreement?

   To find the text and related materials to the Kyoto Protocol visit the following websites:

   www.eia.doe.gov/oiaf/kyoto/kyotorpt.html

   www.maps.grida.no/kyoto/

8. How do current trends in transportation effect the amount of CO_2 in the atmosphere?

   Have the students investigate the changes in transportation systems around the world. There were 513 million cars on the globe in 1996. That number is expected to rise to over 593 million by 2005. What will be the role of mass transit? Will residents in India and China all have cars in the future?

For more information about climate change and CO_2, check out the Global Warming pages in the Easy Breathers Library.

Extension:

The average American contributes 20 tons of CO_2 to the atmosphere each year. Have your students use the worksheet "Calculate your CO_2 production" to see what they contribute.